OIPE JC106 FEB 2 2 2005 PATENT & TRADEMARK OFFICE

Practitioner's

Docket No. SJO920010142US1
PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:
H.S. Gill :
Serial No.: 10/081,046 : Group No.: 2653
Filed: 02/20/02 : Examiner: C. Magee
For: Magnetoresistance Sensor Having An Antiferomagnetic Pinning Layer With Both Surfaces Pinning Ferromagnetic Bias Layers

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313

TRANSMITTAL OF APPEAL BRIEF
(PATENT APPLICATION-37 C.F.R. 1.192)

1. Transmitted herewith is the APPEAL BRIEF in this Application, with respect to the Notice of Appeal filed on 9/20/04.

2. STATUS OF APPLICANT
This application is on behalf of
__x___other that a small entity.

3. FEE FOR FILING APPEAL BRIEF
Pursuant to 37 C.F.R. 1.17(f), the fee for filing the Appeal Brief for other than a small entity is **$0.00**.

4. EXTENSION OF TERM
The proceedings herein are for a patent application and the provisions of 37 C.F.R. 1.136 apply.

(a) Applicant petitions for an extension of time under 37 C.F.R. 1.136 for the total number of months checked below:

Extension (months)	Fee for other than small entity
____ one month	$ 110.00
____ two months	$ 430.00
____ three months	$ 980.00

____ four months $1530.00

__ Please charge my Deposit Account No. __09-0466__ in the amount of $0.00
A duplicate copy of this sheet is attached.

_X_ The Commissioner is hereby authorized to charge payment of the following fees associated with this communication or credit any overpayment to Deposit Account__09-0466__. A duplicate copy of this sheet is attached.

_X_ Any filing fees under 37 CFR 1.16 for the presentation of extra claims.

_X_ Any patent application processing fees under 37 CFR 1.17.

Respectfully submitted,

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CERTIFICATE OF MAILING

I hereby certify that the above paper/fee is deposited with the United States Postal Service as first class mail in an envelope addressed to the Commissioner For Patents P.O Box 1450 Alexandria, Va 22313 on 2/16/05.

Person Mailing paper/fee

Darci Manuleleua

Signature__________

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	H. S. Gill	:	Group Art Unit: 2452
Serial No.:	10/081,046	:	Examiner: C. Magee
Filed:	02/20/02	:	
		:	

Title: **Magnetoresistance Sensor Having an Antiferromagnetic Pinning Layer With Both Surfaces Pinning Ferromagnetic Bias Layers**

APPELLANTS' BRIEF (37 CFR 1.192)

Assistant Commissioner for Patents
Washington, DC 20231

Attention: Board of Patent Appeals and Interferences

Dear Sir:

This brief is in furtherance of the Notice of Appeal for the above application, which was mailed to the U.S. Patent and Trademark Office on 09/20/04.

The fees required §1.17(f) and any required petition for extension of time for filing this brief and fees therefor are dealt with in the accompanying transmittal of appeal brief. This brief is transmitted in triplicate. (37 CFR 1.192(a))

This brief contains these items under the following headings and in the order set forth below:

The final page of this brief bears the attorney's signature.

I. REAL PARTY IN INTEREST

The real party in interest is International Business Machines Corporation.

II. RELATED APPEALS AND INTERFERENCE

None.

III. STATUS OF CLAIMS

A. The Application was filed with 20 claims. New claims 21-23 were added in the response to the first Office Action submitted on 01/05/04. Claims 1-23 remain in the case. Claims 6 and 17 are allowed. Claims 1-5, 7-16 and 18-23 have been finally rejected.

IV. STATUS OF AMENDMENTS

All amendments have been entered by the Examiner.

V. SUMMARY OF CLAIMED SUBJECT MATTER

Claim 1: Claim 1 recites a magnetoresistance (MR) sensor structure 50 made of a series of layers that are very thin in relation to their lateral extent. The MR sensor structure 50 includes a magnetoresistance sensor 52 which may be of any operable type. The MR sensor structure 50, having a sensor surface plane 54, includes an upper antiferromagnetic layer 62 positioned between an upper ferromagnetic layer 64 and a free layer 60 (Page 5, line 33 to page 7, line 6 and Fig. 2). The upper antiferromagnetic layer 62 overlays at least a portion of the free layer 60 (Page 6, lines 16-17). The upper ferromagnetic layer 64 overlays and contacts at least a portion of the upper antiferromagnetic layer 62 on a contact face 66 lying parallel to the sensor surface plane 54 so that the upper antiferromagnetic layer 62 lies between the upper ferromagnetic layer 64 and the free layer 60 (Page 6, lines 21-25). With this arrangement, the upper antiferromagnetic layer 62 exchange couples to and pins the contacted portion of the neighboring ferromagnetic free layer 60 through the first contact face 63 and also exchange couples to and pins the contacted portion of the upper ferromagnetic layer 64 through the second contact face 66. Thus, both faces of the upper antiferromagnetic layer 62 are utilized for pinning. (Page 6, lines 27-32)

Claim 7: Claim 7 defines a magnetoresistance (MR) sensor structure 50 (Fig. 2) which can be implemented as a giant magnetoresistance (GMR) sensor structure 70 (Fig. 3) or a tunnel magnetoresistance (TMR) sensor structure 78 (Fig. 4) (Page 7, lines 7-11). The MR sensor structure 70 or 78 comprises an MR sensor 52 (Fig. 5). The MR sensor 52 comprises a lower antiferromagnetic layer 100 or pinning layer and a free layer 60 overlying the lower antiferromagnetic layer 100 (Page 8, lines 13-32 and Fig. 5). An upper antiferromagnetic layer 62 overlays at least a portion of the free layer 60 and an upper ferromagnetic layer 64 overlies and contacts at least a portion of the upper antiferromagnetic layer 62 on a contact face 66 lying parallel to the surface plane 64, so that the upper antiferromagnetic layer 62 lies between the upper ferromagnetic layer 64 and the free layer 60 (Page 6, lines 16-26 and Figs. 2, 3 and 4). For a GMR sensor structure 70, the layers 62 and 64 are defined as discrete exchange tabs 72 upon the free layer 60, leaving a central portion 74 without the overlying layers 62 and 64 (Page 7, lines 12-14 and Fig. 3).

Claim 13: An MR sensor structure 50 is defined comprising a MR sensor 70 having a sensor surface plane 54 (Fig. 2) comprising a lower antiferromagnetic layer 100 and a free layer 60 (Fig. 5), and an upper antiferromagnetic layer 62, an upper ferromagnetic layer 64 and a cap layer 68 (Fig. 3) where the upper antiferromagnetic layer 62 and the upper ferromagnetic layer 64 overlie a first portion 72 of the free layer 60 that is less than all of the free layer and the upper ferromagnetic layer 64 contacting the upper antiferromagnetic layer 62 on a contact face 66 lying

parallel to the sensor surface plane 54 so that the upper antiferromagnetic layer 62 lies between the upper ferromagnetic layer 64 and the free layer 60 (Page 6, lines 16-25, page 7, lines 12-16, Figs. 2 and 3). The cap layer 68 overlies a second portion 74 of the free layer 60 (Page 7, lines 14-15, Fig. 3).

Claim 18: Defined is an MR sensor structure 50 comprising an MR sensor 52 having a sensor surface plane 54, a transverse direction 56 lying in the sensor surface plane 54, and a longitudinal direction 58 lying in the sensor surface plane 54 and perpendicular to the transverse direction 56 (Page 6, lines 1-8, Fig. 2). The MR sensor 52 comprises a transverse biasing stack including a lower antiferromagnetic layer 100, or pinning layer, and a free layer 60 overlying the transverse biasing stack (Page 3, lines 15-17, page 8, lines 13-32, and Fig. 5). A longitudinal biasing stack overlying the MR sensor 52 (Page 3, line 18) comprises an upper antiferromagnetic layer 62 and an upper ferromagnetic layer 64 overlying and contacting at least a portion 72 of the antiferromagnetic layer 62 on a contact face 66 lying parallel to the sensor surface plane 54, so that the upper antiferromagnetic layer 62 lies between the upper ferromagnetic layer 64 and the MR sensor 52 (Page 3, lines 18-23, page 6, lines 21-25, and Fig. 3).

Claim 21: Claim 21 recites the MR sensor structure 50 as claimed in claim 1 with the additional limitations (emphasized) that the upper antiferromagnetic layer 52 overlies at least a portion of the free layer 60 ***in a plane parallel to the sensor surface plane*** 54, and that the

antiferromagnetic layer 52 lies between the upper ferromagnetic layer and the free layer 60 ***in a plane parallel to the sensor surface plane*** 54 (Page 18-23, page 6, lines 16-25, and Figs. 2-4).

Claim 22: Claim 22 recites the MR sensor structure 50 as claimed in claim 7 with the additional limitations (emphasized) that the upper antiferromagnetic layer 52 overlies at least a portion of the free layer 60 ***in a plane parallel to the sensor surface plane*** 54, and that the antiferromagnetic layer 52 lies between the upper ferromagnetic layer and the free layer ***in a plane parallel to the sensor surface plane*** 54 (Page 18-23, page 6, lines 16-25, and Fig. 2-4).

Claim 23: Claim 23 recites the MR sensor structure 50 as claimed in claim 18 with the additional limitation (emphasized) that the antiferromagnetic layer 52 lies between the upper ferromagnetic layer and the magnetoresistance sensor 52 ***in a plane parallel to the sensor surface plane*** 54 (Page 18-23, page 6, lines 16-25, and Figs. 2-4).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

A. Whether the Examiner has properly rejected claims 1-4, 7-15, 18, 19 and 21-23 as being anticipated by Hasegawa et al. (U.S. Pat. # 6,496,338 B2) under 35 U.S.C. 102(e).

B. Whether the Examiner has properly rejected claims 5, 16 and 20 as being unpatentable over Hasegawa et al. (U.S. Pat. # 6,496,338 B2) in view of Gill (U.S. Pat. # 6,052,263) under 35 U.S.C. 103(a).

VIII. ARGUMENT

A. Rejection under 35 U.S.C. 102(e):

i. Claims 1-4, 7-15, 18 and 19:

The Examiner has rejected claims 1-4, 7-15, 18, 19, and 21-23 under 35 U.S.C. 102(e) as being anticipated by Hasegawa et al. (U.S. Pat. # 6,496,338 B2).

Applicant traversed this rejection on the ground that the reference does not teach every element of the claim (MPEP 2131).

First, claim 1 recites, in relevant part, the following limitation:

> "an upper antiferromagnetic layer overlying at least a portion of the free layer;"
>
> (Claim 1, line 4-5).

In contrast, Hasegawa et al. teaches "--the antiferromagnetic layers 46 are provided so that the ends thereof cover the sides of the antiferromagnetic layer 41, the pinned ferromagnetic layer 42 and the non-magnetic layer 43, and ***cover the sides of the free ferromagnetic layer 44*** to about half the thickness thereof." (Col. 11, lines 7-12 and Fig. 3)(emphasis added). Thus, the antiferromagnetic layer 46 does not overlie a portion of the free layer as claimed in Applicant's invention, but only covers the sides of the free layer 44. It should be realized that as depicted in Fig. 3, the thickness of the free layer is greatly exaggerated relative to its in plane dimensions so that what may appear to be significant overlap of a portion of the free layer is in reality essentially zero overlap since the sides of the free layer are actually nearly vertical when drawn to scale. The antiferromagnetic layer of Hasegawa et al. fails to overlie the free layer but merely abuts the sides of the free layer.

Second, claim 1 recites, in relevant part, the following limitation:

> "an upper ferromagnetic layer overlying and contacting at least a portion of an upper antiferromagnetic layer ***on a contact face lying parallel to the sensor surface plane, so that the upper antiferromagnetic layer lies between the upper ferromagnetic layer and the free layer***." (Claim 1, lines 6-9) (emphasis added)

Hasegawa teaches "The ferromagnetic layer 47 on the antiferromagnetic layers 46 are provided so that the ends thereof cover the ***sides*** of the free ferromagnetic layer 44 to about half of the thickness thereof." (Col. 11, lines 12-15 and Fig. 3) (emphasis added). The ferromagnetic layer 47 and the antiferromagnetic layers 46 fail to cover the free ferromagnetic layer on a contact surface that is parallel to the sensor surface plane but rather on a plane more nearly perpendicular to the sensor surface plane. The ferromagnetic layer 47 and the antiferromagnetic layers 46 merely abut the ***sides*** of the free layer so that the antiferromagnetic layer only comes between the ferromagnetic layer and the free layer over a negligible portion of the free layer on the sides that are not on a plane parallel to the sensor surface plane. Applicant submits that the limitation to "--a contact face lying parallel to the sensor surface plane --" clearly distinguishes from the reference and is therefore not anticipated.

In his response to Applicant's arguments to this rejection of the First Office Action, the Examiner maintained that Fig. 3 of Hasegawa clearly illustrates an upper antiferromagnetic layer 46 overlying at least a portion of the free layer 44 as claimed in the present invention. Applicant respectfully points out that because Fig. 3 of Hasegawa is not drawn to scale, it is grossly

misleading to rely on this figure to conclude that the upper ferromagnetic layer overlies at least a portion of the free layer. It should be recognized that the width of the free layer 44 is 2 microns (Col. 14, lines 1-4) while the thickness of the free layer 44 is 75 angstroms (Col. 13, lines 59-63). The end regions were removed by a process of photolithography and ion milling which is known to result in steep walls approaching 90 degrees to the plane of the sensor. Clearly the portion of the free layer 44 that the antiferromagnetic layer 46 can possibly overlay is less than 0.00375 of the free layer width that is calculated assuming a sidewall angle of 45 degrees. If Fig. 3 were drawn to scale, the amount of overlay represented by the sidewall of free layer 44 would be negligible. When taken with the teaching in the Hasegawa reference that "--the antiferromagnetic layers 46 are provided so that the ends thereof cover the sides of the antiferromagnetic layer 41, the pinned ferromagnetic layer 42 and the non magnetic layer 43, and ***cover the sides of the free ferromagnetic layer 44*** to about half the thickness thereof." (Col. 11, lines 7-12) (emphasis added), the Examiner's conclusion that the upper antiferromagnetic layer overlies at least a portion of the free layer is not a reasonable one. The antiferromagnetic layer of Hasegawa et al. fails to overlie the free layer and merely abuts the sides of the free layer.

In the Final Office Action and in the Advisory Action, the Examiner failed to address the limitation on "an upper ferromagnetic layer overlying and contacting at least a portion of the upper antiferromagnetic layer ***on a contact face lying parallel to the sensor surface plane*** --". Applicant submits that this limitation is not taught by the Hasegawa et al. reference and is distinct from the issue of whether the antiferromagnetic layer overlays at least a portion of the free layer as maintained by the Examiner.

ii. **Claims 21-23**

In Applicant's response to the First Office Action, new claims 21-23 were added including the limitations:

> "an upper antiferromagnetic layer overlying at least a portion of the free layer ***in a plane parallel to the sensor surface plane***; and
>
> an upper ferromagnetic layer overlying and contacting at least a portion of the upper antiferromagnetic layer on a contact face lying parallel to the sensor surface plane, so that the upper antiferromagnetic layer lies between the upper ferromagnetic layer and the free layer ***in a plane parallel to the sensor surface plane***." (Claim 21, lines 4-9) (emphasis added)

Applicant believes that new claims 21-23 are patentably distinct from the Hasegawa et al. reference and are therefore in condition for allowance. In the Final Action and in the Advisory Action, the Examiner failed to address the above limitations of claims 21-23 which clearly differ from the limitations of claim 1, 7 and 18, respectively, by the added phrases emphasized above.

Applicant considers that claims 21-23 are separately patentable from claims 1-5, 7-16 and 18-20 at issue in this appeal since even if the Examiner's rejection of claims 1-5, 7-16 and 18-20 is upheld on the grounds that the upper antiferromagnetic layer overlies the free layer as is maintained by the Examiner rather than merely abutting the steep sides of the free layer, claims 21-23 are patently distinct since Hasegawa et al. fails to teach or suggest (1) an upper antiferromagnetic layer overlying at least a portion of the free layer ***in a plane parallel to the***

sensor surface plane; and (2) an upper ferromagnetic layer overlying and contacting at least a portion of the upper antiferromagnetic layer on a contact face lying parallel to the sensor surface plane, so that the upper antiferromagnetic layer lies between the upper ferromagnetic layer and the free layer ***in a plane parallel to the sensor surface plane*** as claimed in the invention.

B. <u>Rejection under 35 U.S.C. 103(a)</u>

i. <u>Claims 5, 16 and 20:</u>

The Examiner has rejected claims 5, 16 and 20 as being unpatentable over Hasegawa et al. (U.S. Pat. # 6,496,338 B2) in view of Gill (U.S. Pat. # 6,052,263) under 35 U.S.C. 103(a).

Applicant traversed this rejection on the grounds that a Prima Facie Case of Obviousness has not been established because the references fail to teach or suggest all the elements of the claims (MPEP 2143.03).

Claims 5, 16 and 20 are dependent on independent claims 1, 7 and 18, respectively. As discussed above with respect to the section 102(e) rejection of claims 1, 7 and 18, the Hasegawa reference (1) fails to teach or suggest an upper antiferromagnetic layer overlying at least a portion of a free layer; (2) fails to teach or suggest an upper antiferromagnetic layer lying between an upper ferromagnetic layer and a free layer, since the reference only discloses an upper ferromagnetic layer and an upper antiferromagnetic layer that abut the ***sides*** of the free layer; and 3) fails to teach or suggest an upper ferromagnetic layer overlying and contacting at least a portion of an upper antiferromagnetic layer on a contact face lying parallel to the sensor surface plane. The Gill reference teaches a magnetic tunnel junction sensor, but is silent with respect to

1) an upper antiferromagnetic layer overlying at least a portion of a free layer, 2) an upper antiferromagnetic layer lying between an upper ferromagnetic layer and a free layer of a magnetoresistance sensor, and 3) an upper ferromagnetic layer overlying and contacting at least a portion of an upper antiferromagnetic layer on a contact face lying parallel to the sensor surface plane.

Since the combined references fail to teach or suggest all the elements of the base claims 1, 7 and 18 on which claims 5, 16 and 20 depend, Applicant submits that the Office has failed to establish a Prima Facie Case of Obviousness.

Summary of the argument

Applicant believes that the above arguments provide a reasoned and substantive case for traversing the 35 U.S.C. 102(e) rejection of the claims. Applicant respectfully disagrees with the Examiner's position that the Hasegawa et al. reference shows an upper antiferromagnetic layer overlying at least a portion of the free layers claimed in the present invention. The Examiner appears to rely entirely on Fig. 3 of the reference which is drawn grossly out of scale and he completely ignores the Hasegawa et al. teaching that the antiferromagnetic layers are provided to cover the ***sides*** of the free ferromagnetic layer to about half its thickness. In addition, the Examiner has failed to consider the claim limitations reciting parallelism of the second antiferromagnetic and second ferromagnetic layers to the sensor surface plane which further distinguish the present invention from the apparent overlap at the sides of the free ferromagnetic layer of Hasegawa et al. Applicant submits that the Hasegawa et al. reference fails to teach each

and every element set forth in the claims as required (MPEP 2131) and, therefor, the 102(e) rejection is not proper. A speedy allowance of all the claims is respectfully requested.

IX. APPENDIX OF CLAIMS INVOLVED IN THE APPEAL

Claim 1. (Original): A magnetoresistance sensor structure comprising:

a magnetoresistance sensor having a sensor surface plane and comprising a free layer;

an upper antiferromagnetic layer overlying at least a portion of the free layer; and

an upper ferromagnetic layer overlying and contacting at least a portion of the upper antiferromagnetic layer on a contact face lying parallel to the sensor surface plane, so that the upper antiferromagnetic layer lies between the upper ferromagnetic layer and the free layer.

Claim 2. (Original): The magnetoresistance sensor structure of claim 1, wherein the upper antiferromagnetic layer is PtMn and the upper ferromagnetic layer is CoFe.

Claim 3. (Original): The magnetoresistance sensor structure of claim 1, wherein the magnetoresistance sensor is a giant magnetoresistance sensor.

Claim 4. (Original): The magnetoresistance sensor structure of claim 1, wherein the upper antiferromagnetic layer and the upper ferromagnetic layer overlie a first portion of the free layer that is less than all of the free layer, and further including

a cap layer overlying a second portion of the free layer.

Claim 5. (Original): The magnetoresistance sensor structure of claim 1, wherein the magnetoresistance sensor is a tunnel magnetoresistance sensor.

Claim 7. (Original): A magnetoresistance sensor structure comprising:

a magnetoresistance sensor having a sensor surface plane and comprising:

a lower antiferromagnetic layer, and

a free layer overlying the lower antiferromagnetic layer;

an upper antiferromagnetic layer overlying at least a portion of the free layer; and

an upper ferromagnetic layer overlying and contacting at least a portion of the upper antiferromagnetic on a contact face lying parallel to the sensor surface plane, so that the upper antiferromagnetic layer lies between the upper ferromagnetic layer and the free layer.

Claim 8. (Previously amended): The magnetoresistance sensor structure of claim 7, wherein the lower antiferromagnetic layer and the upper antiferromagnetic layer are made of the same material.

Claim 9. (Original): The magnetoresistance sensor structure of claim 7, wherein the lower antiferromagnetic layer and the upper antiferromagnetic layer are both PtMn.

Claim 10. (Original): The magnetoresistance sensor structure of claim 7, wherein the upper ferromagnetic layer is CoFe.

Claim 11. (Original): The magnetoresistance sensor structure of claim 7, wherein the magnetoresistance sensor is a giant magnetoresistance sensor.

Claim 12. (Original): The magnetoresistance sensor structure of claim 7, wherein the upper antiferromagnetic layer and the upper ferromagnetic layer overlie a first portion of the free layer that is less than all of the free layer.

Claim 13. (Previously amended): A magnetoresistance sensor structure comprising:

a magnetoresistance sensor having a sensor surface plane and comprising:

a lower antiferromagnetic layer, and

a free layer overlying the lower antiferromagnetic layer;

an upper antiferromagnetic layer overlying a first portion of the free layer that is less than all of the free layer;

an upper ferromagnetic layer overlying a first portion of the free layer that is less than all of the free layer and contacting the upper antiferromagnetic layer on a contact face lying parallel to the sensor surface plane, so that the upper antiferromagnetic layer lies between the upper ferromagnetic layer and the free layer; and

a cap layer overlying a second portion of the free layer.

Claim 14. (Original): The magnetoresistance sensor structure of claim 7, wherein the upper antiferromagnetic layer and the upper ferromagnetic layer overlie a first portion of the free layer that is less than all of the free layer, and further including

a lead layer overlying the upper ferromagnetic layer.

Claim 15. (Original): The magnetoresistance sensor structure of claim 7, wherein the upper antiferromagnetic layer and the upper ferromagnetic layer overlie a first portion of the free layer that is less than all of the free layer, and further including

a lead layer overlying the upper ferromagnetic layer; and

a cap layer overlying a second portion of the free layer.

Claim 16. (Original): The magnetoresistance sensor structure of claim 7, wherein the magnetoresistance sensor is a tunnel magnetoresistance sensor.

Claim 18. (Original): A magnetoresistance sensor structure comprising:

a magnetoresistance sensor having a sensor surface plane, a transverse direction lying in the sensor surface plane, and a longitudinal direction lying perpendicular to the transverse direction and in the sensor surface plane, the magnetoresistance sensor comprising:

a transverse biasing stack including a lower antiferromagnetic layer, and

a free layer overlying the transverse biasing stack; and

a longitudinal biasing stack overlying the magnetoresistance sensor, the longitudinal biasing stack comprising:

an upper antiferromagnetic layer, and

an upper ferromagnetic layer overlying and contacting at least a portion of the upper antiferromagnetic layer on a contact face lying parallel to the sensor surface plane, so that the upper antiferromagnetic layer lies between the upper ferromagnetic layer and the magnetoresistance sensor.

Claim 19. (Original): The magnetoresistance sensor structure of claim 18, wherein the magnetoresistance sensor is a giant magnetoresistance sensor.

Claim 20. (Original): The magnetoresistance sensor structure of claim 18, wherein the magnetoresistance sensor is a tunnel magnetoresistance sensor.

Claim 21. (Currently amended): A magnetoresisance sensor structure comprising:

a magnetoresistance sensor having a sensor surface plane and comprising:

a free layer;

an upper antiferromagnetic layer overlying at least a portion of the free layer in a plane parallel to the sensor surface plane; and

an upper ferromagnetic layer overlying and contacting at least a portion of the upper antiferromagnetic layer on a contact face lying parallel to the sensor surface plane, so that the

upper antiferromagnetic layer lies between the upper ferromagnetic layer and the free layer in a plane parallel to the sensor surface plane.

Claim 22. (Currently amended): A magnetoresistance sensor structure comprising:

a magnetoresistance sensor having a sensor surface plane and comprising:

a lower antiferromagnetic layer;

a free layer overlying the lower antiferromagnetic layer;

an upper antiferromagnetic layer overlying at least a portion of the free layer in a plane parallel to the sensor surface plane; and

an upper ferromagnetic layer overlying and contacting at least a portion of the upper antiferromagnetic layer on a contact face lying parallel to the sensor surface plane, so that the upper antiferromagnetic layer lies between the upper ferromagnetic layer and the free layer in a plane parallel to the surface plane.

Claim 23. (Previously presented): A magnetoresistance sensor structure comprising:

a magnetoresistance sensor having a sensor surface plane, a transverse direction lying in the sensor surface plane, and a longitudinal direction lying perpendicular to the transverse direction and in the sensor surface plane, the magnetoresistance sensor comprising:

a transverse biasing stack including a lower antiferromagnetic layer;

a free layer overlying the transverse biasing stack; and

a longitudinal biasing stack overlying the magnetoresistance sensor, the longitudinal biasing stack comprising:

an upper antiferromagnetic layer; and

an upper ferromagnetic layer overlying and contacting at least a portion of the upper antiferromagnetic layer on a contact face lying parallel to the sensor surface plane, so that the upper antiferromagnetic layer lies between the upper ferromagnetic layer and the magnetoresistance sensor in a plane parallel to the sensor surface plane.

Dated: 2/16/05

Respectfully submitted,

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